Space Weather Technical Forecast

Issued on Wednesday, 19 April 2023 at 12:40 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

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Space Weather Forecast Headline: G1/Minor Storms likely due to CME activity, with a chance of G2/Moderate or G3/Strong Storms on 20 and 21 April. Chance of M-class flares (R1-R2 Minor-Moderate radio blackouts) throughout.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been Low with occasional C-class flares observed and peaking at C4.8 from AR3280 at 18/1529TC. AR3280 rotated across the western limb during 17 April. There are currently seven active regions on the visible disc. AR3282 is the largest and located in the north, near centre disc. The remaining groups are small and simple, and appear to be either stable or in slow decay.

No Earth-directed CMEs have been observed in available imagery during the last 24 hours.

Solar Wind / Geomagnetic Activity: The solar wind observed at L1 was slightly elevated to start the period before a change to elevated levels in response to a CME arrival around 18/1400UTC, with a peak of 623 km/s observed at 18/2033UTC. A slow decline was observed after midnight UTC, with speeds currently near 500km/s. Density was at below average levels before becoming above average from around 18/1400UTC with a peak of 33ppcc observed at 18/1637UTC. Total magnetic field strength was at weak to moderate levels, before becoming strong for a few hours after 18/1400UTC, then slowly declined back to current average levels. The important north-south component was also at weak to moderate levels with a period of negative orientation observed around 18/1600UTC as strong levels were reached, with a peak of -17 nT recorded at 18/1549UTC. Weak levels resumed after 18/2100UTC. The phi angle was mainly negative (towards the sun). Geomagnetic activity was initially Quiet (Kp 1) becoming Active (Kp 4) by 18/1500UTC, with a period of G1/minor geomagnetic storms (Kp 5) from 18/1500-1800UTC. Activity then slowly subsided after midnight UTC.

Energetic Particles / Solar Radiation: High energy proton flux (greater than 10MeV) as measured at GOES16, was at background levels. High energy electron flux (greater than 2MeV) as measured at GOES16 was at background to moderate levels. The associated 24-hour integrated electron fluence was well below the Active threshold on a steady trend, with 1.52e6 integrated pfu observed at 19/0000UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is expected to be generally Low, with a likelihood of isolated Moderate activity, mainly due to AR3282. There is also a chance for activity from a region beyond the northeastern limb, which is forecast to rotate onto the visible disc by day 2 (20 Apr).

Solar Wind / Geomagnetic Activity: Two CMEs may affect the Earth in this period. The first carries low confidence for a glancing blow on day 1 (19 Apr), with a further more direct CME hit,

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forecast on days 2 or 3 (20 or 21 Apr). Otherwise solar winds are expected to become slightly elevated with an initial period at elevated levels as a result of the CME that impacted the Earth on 18 April.

Geomagnetic activity is forecast to be Quiet to Unsettled, with a chance of Active to G1/Minor storm intervals (Kp 4-5) due to the potential glancing CME on 19 Apr. Activity is likely to reach G1/Minor Storm levels (Kp5) on 20 or 21 Apr due to the anticipated second CME arrival, with a chance of G2/Moderate (Kp6) or G3/Strong Storm (Kp7) conditions.

Energetic Particles / Solar Radiation: High energy (greater than 10MeV) proton flux is most likely to persist at background levels, although there is a very slight chance of a S1 or greater event. High energy (greater than 2 MeV) electron flux is currently at background to moderate levels with little change probable throughout much of the period. The associated 24-hour integrated fluence is expected to remain below the Active threshold (1e8 integrated pfu).

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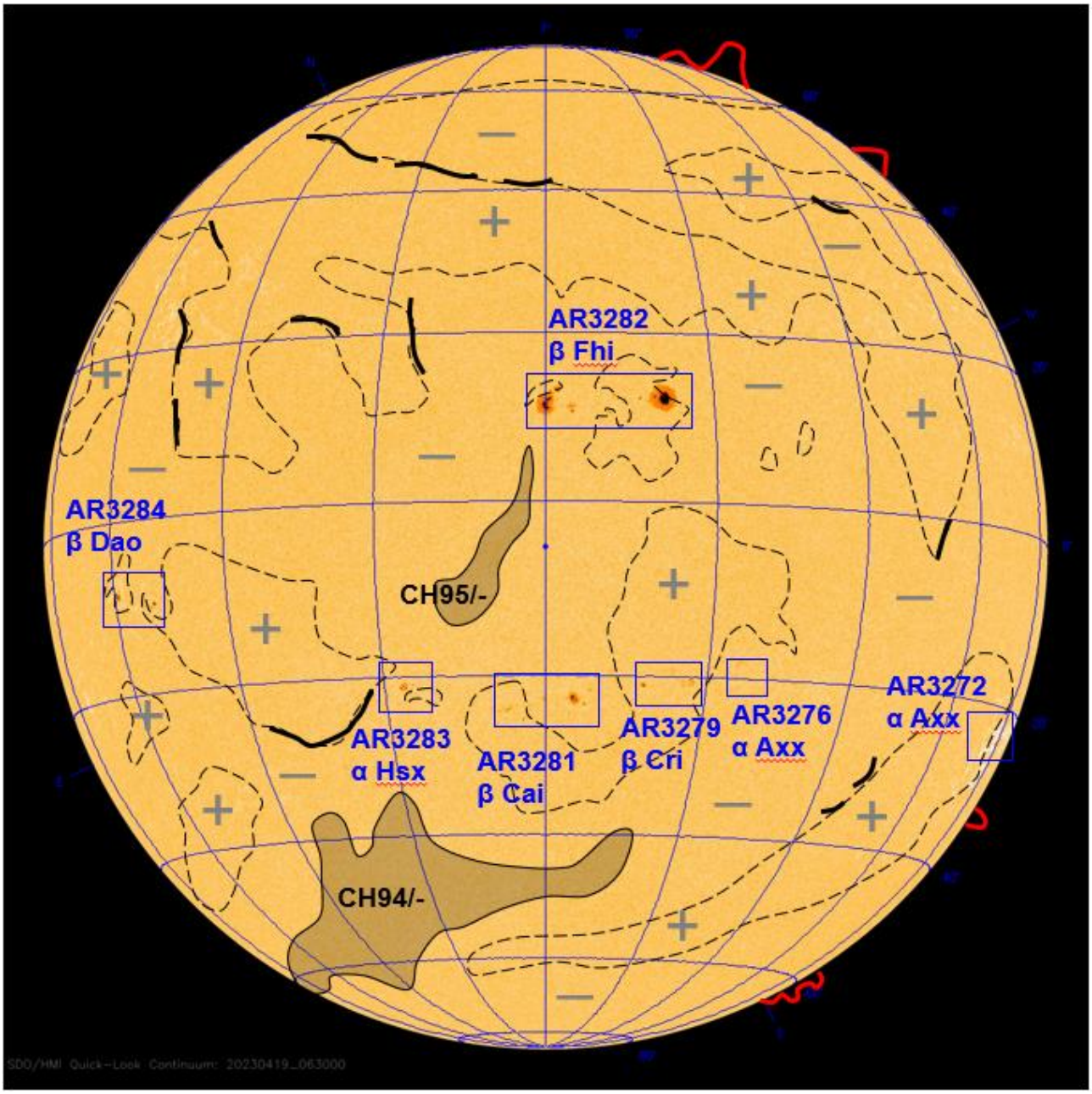
Figure 1. Solar Analysis Valid 19/0700UTC.



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Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

A couple of CMEs have been analysed with the potential to affect Earth during the forecast period. The first, a filament eruption at around 15/1100UTC is forecast to potentially glance the Earth during day 1 (19 Apr), but the majority if not all of the CME is expected to pass behind Earth-orbit. A faint CME halo from a large filament eruption later that same day (15/2324UTC) is more likely to affect Earth, arriving on either day 2 or 3 (20 or 21 Apr). Confidence in the arrival time and geomagnetic effects is only moderate given the apparent diffuse signature of the CME in LASCO C2 and C3 imagery and limited STEREO A data for the event. A broad expected arrival window from early on 20 Apr until the end of 21 Apr is the most likely arrival time of the CME.

Earth is currently in an elevated but declining solar wind regime following the impact of the CME on 18 April. Solar winds should decline back to slightly elevated levels ahead of the potential CME arrivals in the coming days 1 to 3 (19-21 Apr). The next CH high-speed stream is not expected to become geo-effective until around 23 Apr, although given the high southern latitude of the feature, any connection carries rather low confidence.
Geomagnetic activity is forecast to be Quiet to Unsettled, with a chance of Active to G1/Minor storm intervals (Kp 4-5) due to the potential glancing CME on 19 Apr. Activity is likely to reach G1/Minor Storm levels (Kp5) on 20 or 21 Apr due to the anticipated second CME arrival, with a chance of G2/Moderate (Kp6) or G3/Strong Storm (Kp7) conditions.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	**G1 to G2**	Yes	50	60	60	30
Strong	**G3**	No	10	30	30	10
Severe	**G4**	No	1	5	5	1
Extreme	**G5**	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
16/0550l	Partial	Filament eruption	NW	250 km/s	19/1200UTC +/- 9 hrs	Low confidence
16/1343	Full	Filament eruption	NW	342 km/s	20/1300UTC +/- 12 hrs	Possible G2/G3 storms. Low confidence.

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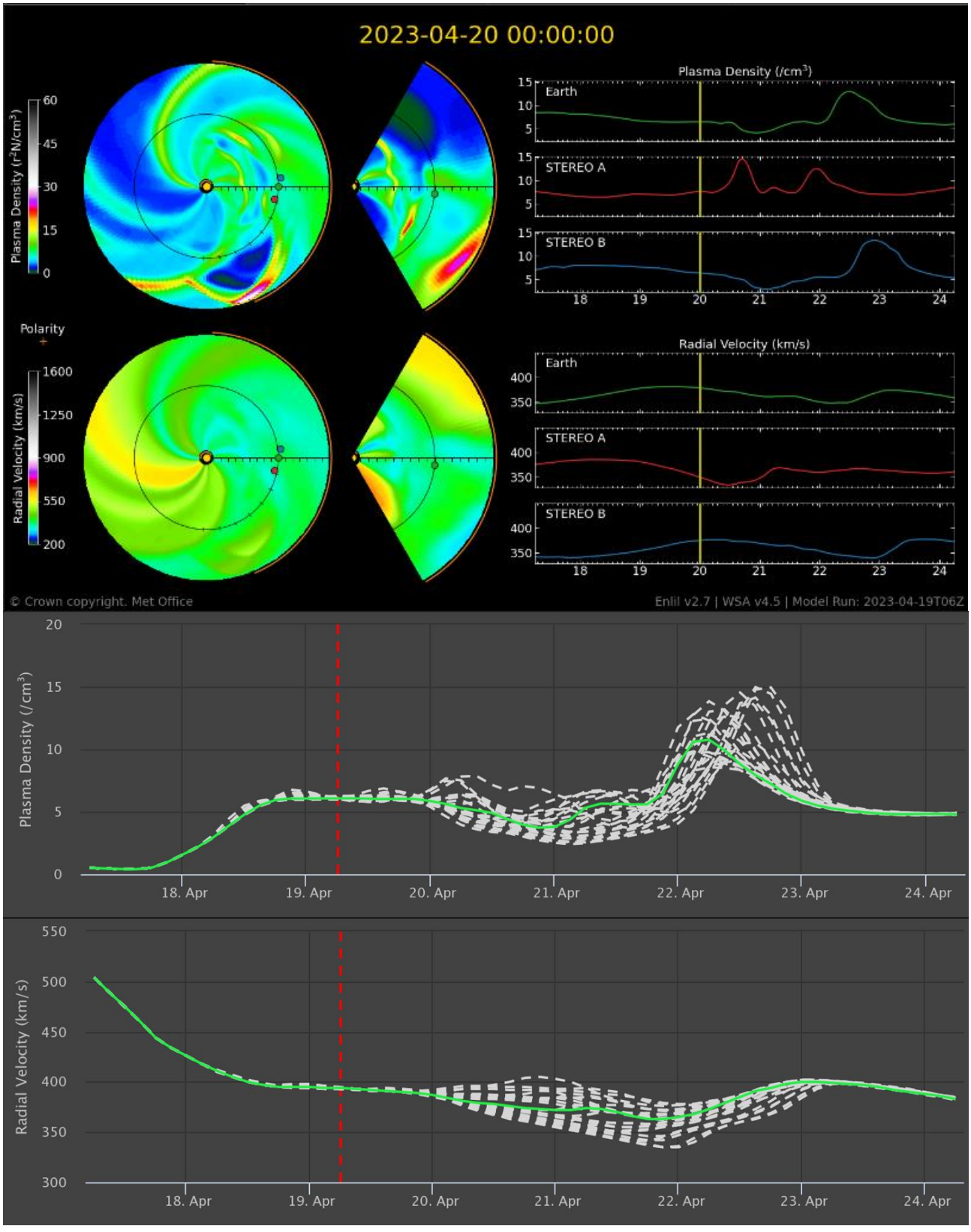
Figure 2: Latest ENLIL output, including ensemble guidance, with large temporal spread for arrival time of second CME.



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Radio Blackouts - X-Ray Flares:

There are currently seven active regions on the visible disc. AR3282 is the largest and located in the north, near centre disc. The remaining groups are small and simple, and appear to be either stable or in slow decay.

A new region beyond the northeast limb appears bright on SDO AIA 94 imagery and could reveal a sunspot group as it rotates onto the visible disc by day 2 (20 Apr). The position of the group would match up with Ex-AR3264 from the previous rotation. Low solar activity is predicted in general, with a likelihood of isolated M-class flares and just a very slight chance of X-class flaring during the guidance period.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	40	40	50	50
Very Active	R3 to R5 X Class	No	1	1	5	5

Solar Radiation Storms - (High Energy Protons):

High energy proton flux (greater than 10MeV), as observed by GOES16, is most likely to remain at background levels through the period. AR3280 which rotated over the western limb during 17 April, carries the greatest initial risk of a proton event.

Radiation Storms	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ S1	No	5	1	1	1
Very Active	≥ S3 *	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

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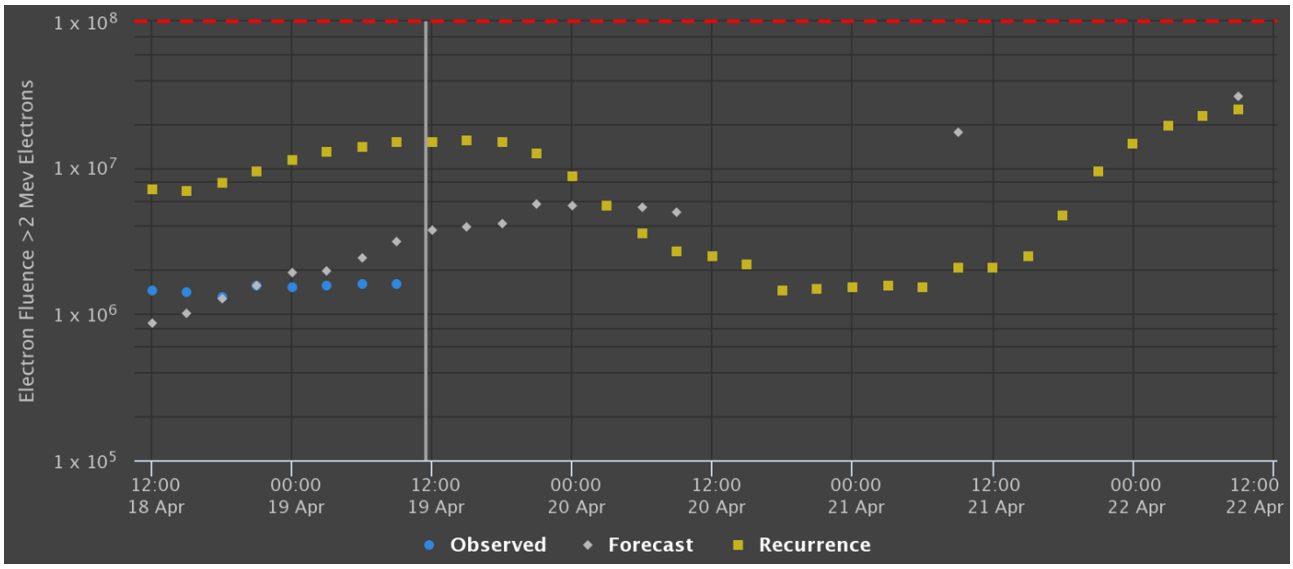
High Energy Electrons Event (≥ 2MeV):
As a result of the current elevated, albeit reducing, solar wind regime affecting Earth this may feed electrons into the radiation belts, resulting in the high energy electron flux (greater than 2MeV) reaching moderate, possibly high levels on days 1 and 2 (19 and 20 Apr). Enhanced geomagnetic activity due to forecast CME arrivals between 19-21 Apr could then lead to a resumed depression, with a gradual increase most likely beyond the end of the forecast period as the geomagnetic activity fades.

Electron fluence is expected to remain below the Active threshold due to the forecast geomagnetic enhancements.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	1	1	5	10
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

Figure 3: MOSWOC REFM latest output.



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